MAR 27 1912

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POWER AND GAS

Devoted to the Conversion, Transmission and Distribution of Energy

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POWER AND GAS
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Cahuenga Pass Showing New Pacific Electric Railway Grade to Lankershim at Left.

PACIFIC ELECTRIC RAILWAY CONSOLIDATION

By Rudolph W. Van Norden
Member A. I. E. E., A. S. C. E.

Los Angeles has long been known as the center of high development in interurban traction. About a year ago this journal published a description of the properties and operation of the Pacific Electric Railway. While this system was at that time by far the largest and most comprehensive centering in the city of Los Angeles, there were two other systems, each in themselves consolidations of smaller and earlier roads.

The first of these, known as the Los Angeles Pacific Company, operated from its own depot in the city of Los Angeles over two main lines of track to the beach section, lying west of the city and between Santa Monica and Redondo. The other system, known as the Los Angeles and Redondo Railway Company, operated between the city and the town of Redondo over two lines of track. The first named system was standard gauge, the latter 3 ft. 6 in. narrow gauge.

These lines of railway were the spokes which covered and served a quadrant of the great wheel of which Los Angeles City is the hub, the remaining three quadrants being covered by the original lines of the Pacific Electric Railway.

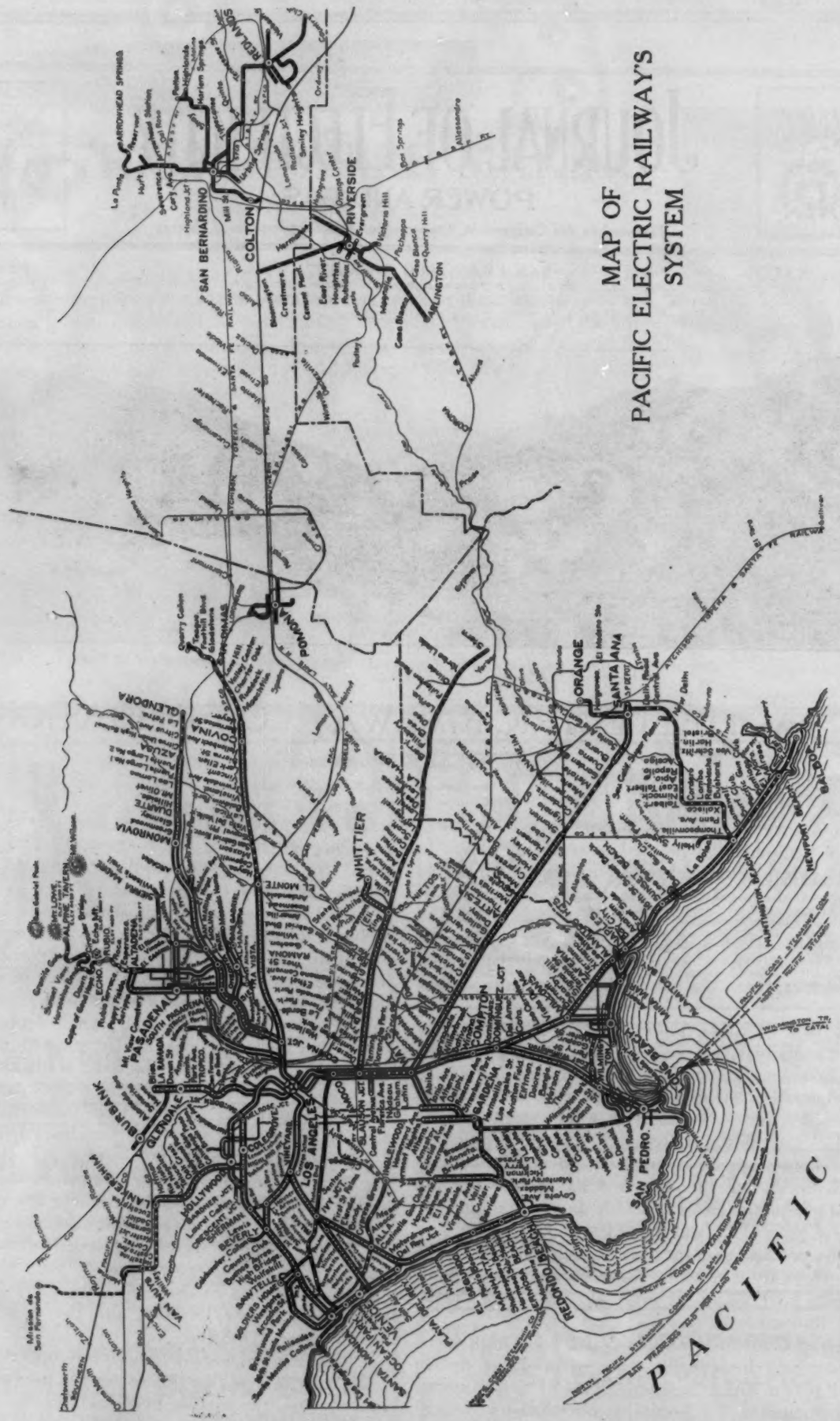
Each of these systems, while ostensibly high speed interurban in character, conducted a large urban business within the congested limits of Los Angeles and in response to this necessity, operated many local street cars. By far the largest part of the street railway business within the congested limits was, however, handled by still another company, the Los Angeles Railway Corporation.

The interests behind all of these roads were more or less uniform and in the fall of 1910 arrangements were made to divide the strictly city street car systems from the long distance interurban lines in such a way that the properties would come under two distinct and separate ownerships and forms of operation. A reorganization was consequently effected, and in February, 1911, the Pacific Electric Railway Company as a holding corporation, came into control of the lines and property of the two interurban systems already mentioned, the Los Angeles Pacific and the Los Angeles and Redondo.

That section of all three companies which handled local street railway business became the property of the Los Angeles Railway Corporation.

Some changes were necessary in the original Pacific Electric system to comply with this consolidation. The first of these was the abolishing of the Los Angeles City Division and the creating of the new Western Division.

The original narrow gauge line operated between Los Angeles and San Pedro by the way of Gardena was divided, the section between the city and Home-


MAP OF
PACIFIC ELECTRIC RAILWAY'S
SYSTEM
SAN BERNARDINO
COLTON
RIVERSIDE
ARROWHEAD SPRINGS
REDLANDS
ONTARIO
POMONA
WHITTIER
ORANGE
SANTA ANA
PASADENA
GLENDALE
BURBANK
LOS ANGELES
HOLLYWOOD
COMPTON
GARDENA
SAN PEDRO
REDONDO BEACH
PACIFIC

ward becoming the property of the city corporation, while the section between Homeward passing through Gardena, to San Pedro, a distance of 14.52 miles, has been broad gauged, together with that part of the Los Angeles and Redondo Gardena line between Gardena and Redondo, and that part of the Inglewood line between Hawthorne and Belvidere, a total distance of about 15 miles.

A new line 2.59 miles long, was built connecting Watts and Homeward, thus creating a direct line from the Sixth and Main Streets' depot, over the four track trunk line of the Southern Division and from there directly to Redondo, a distance of 20.9 miles, this section becoming a part of the Southern Division.

The lines and system of the Los Angeles Pacific, together with the Glendale line, formerly integral with the Angeles City division and the recently electrified Southern Pacific freight line between Amoco Junction and Santa Monica pier, are now known as the Western Division.

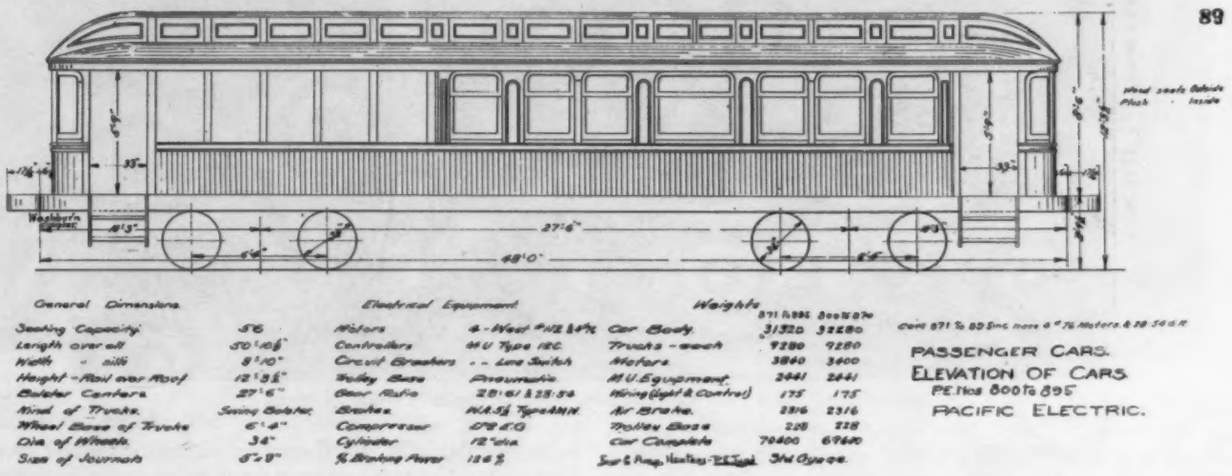
Soon after the consolidation, real estate activities in the San Fernando Valley, in the creation of the towns of Lankershim and the Van Nuys, induced the company to build a new line from Hollywood through the Cahuenga Pass, paralleling the El Camino Real, or King's Highway, the mission road of California, through Lankershim, thence to Van Nuys and finally ending at the San Fernando Mission.

Each of the three divisions, the Northern, Southern and Western, are like great fans, or better, like a tree with its trunk and branches. The Northern and Southern Divisions meet and commence at the Pacific Electric Building at Sixth and Main streets in Los Angeles, and here is the main depot and the nucleus of the entire system from which more trains are daily dispatched than from any five similar depots in the United States.

Western Division.

Cars and trains for the Western Division depart from the station at Fourth and Hill streets. This arrangement is at present necessary, due to the congested condition of streets in the city, but it is eventually proposed to so arrange the outlets from the main depot that all interurban trains may be dispatched from that point. This, however, is a serious problem which will necessitate a great outlay of money and much engineering activity.

This division consists of two main double track lines, leaving the Fourth and Hill Streets' station in opposite directions. The first of these, which was one of the early interurban lines built out of Los Angeles, and known as the Colegrove line, follows South Hill street, passing through two double track concrete lined tunnels, having respective lengths of 545.78 and 975.44 feet, then a northwesterly direction, following one of the many wide boulevards for which this city is famous, passing through the suburb of Colegrove, thence changing in direction to the southwest paralleling the Santa Monica mountains, passing through Sherman, Beverly and Sawtelle, to the city of Santa Monica. There is a loop in this line which passes



Pacific Electric Standard Interurban Car.

Lankershim Line During Construction Through Cahuenga Pass.

through the beautiful suburb of Hollywood joining the Colegrove line at Crescent Junction. There is another loop which leaves the line at Sawtelle, passing the Soldiers' Home and joining the line again at Santa Monica.

The other main line leaving Los Angeles follows South Hill street southward for several blocks and then a westerly direction until the edge of the congested portion of the city is reached at Vineyard, when it passes onto a right-of-way owned by the company. This is known as the Venice Short Line and was built for the purpose of creating a rapid service between Los Angeles and the beaches. This road passes through the suburb of Palms and thence to Venice. A cross line is operated between Vineyard and Beverly and a branch is operated between Palms and Playa del Rey, one of the sea-side resorts. There are a number of other short branches operating more or less local services.

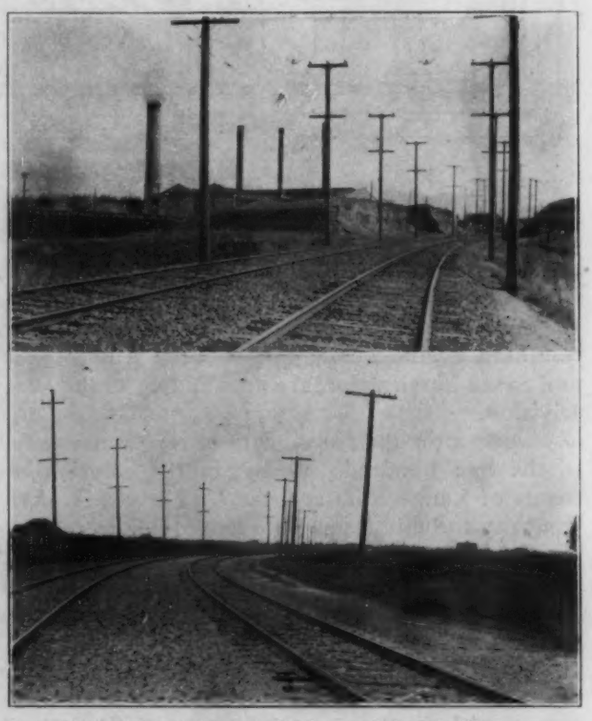
These various lines are connected by an ocean shore line between Santa Monica and Redondo, passing through the famous ocean resorts of Ocean Park, Venice, Playa del Rey and Manhattan. All of the main and cross lines are double tracked.

These beach resorts are older and perhaps better known than the various resorts south of San Pedro, reached by the Southern Division. An enormous amount of money has been expended for bath houses and amusement places of every conceivable order. Thousands of comfortable bungalows and cottages line the well laid out and paved streets close to the beach and every form of amusement and entertainment is in store for the tourist or the resident.

Between Ocean Park and Playa del Rey there are a number of lagoons naturally formed, and these have been wonderfully developed in imitation of the canals, bridges and palaces of ancient Venice.

In each of these places are every accommodation for surf and indoor bathing, furnished by large and well equipped bath houses. At Redondo is one of the largest bath houses in the world with is endless variety of amusement and restaurant features.

The new branch recently constructed from Hollywood into the San Fernando Valley is a fine example



Venice Short Line and Vineyard Power House.
New Line Between Watts and Homeward.

Big Cut at Summit of Cahuenga Pass.

of modern interurban construction. In taking its course through the Cahuenga Pass it was necessary to make a number of very heavy cuts and fills. The largest cut, at the summit, has a length of 950 ft.

Catenary Trolley Along Venice Short Line.

with an average depth of 26 ft., and it was necessary to remove 59,000 cubic yards of rock. This was a particularly treacherous undertaking, as the rock is seamy and extremely difficult to blast. The other cuts, while similar, represented much difficult work, but the resulting grade and alignment furnish a splendid feat of engineering. The entire line is ballasted with broken rock, there being 4700 yards per double track mile. The Pacific Electric standard of construction is maintained throughout, the rails being A. S. C. E. common standard 70 lbs. per yard, the ties of redwood, 16 per 30 foot rail. The grade through the pass is 5 per cent compensated from bottom to summit on the south approach and slightly less on the north approach. There are four trestle bridges, the first crossing the Los Angeles River, being 700 ft. long, double track, and having an average height above the bed of the river of 24 ft.

The second trestle crosses Pecina Wash and is 500 ft. long, also double track. The remaining two trestles are single track, the first being 900 ft. and the second 450 ft. long. These trestles are erected on eight pile bents and follow Southern Pacific standard specifications. The total length of this line under operation is 11.65 miles, of which there are about equal lengths of single and double track road bed. The remainder of the line will soon be ready for regular operation.

A catenary trolley construction is used throughout this branch. It is supported through the Cahuenga Pass with double pole span construction, the poles being 35 ft. long. In the San Fernando Valley the construction is centre pole and bracketed, of standard Electric pattern, the poles being 45 ft. long and carrying a three-phase, 15,000 volt transmission circuit at the top.

Car Handling System.

The economical handling of cars so that there may be system in the repairing work and at the same time a maximum duty from each car is a complex problem. It is the policy of the company to overhaul every car within a certain definite period. It is neces-

sary, to obtain maximum efficiency, that the car leave the shop in perfect condition. It is also necessary that it be kept in perfect condition in order that high-grade service may be maintained. The system must,

Class No.	Total No. Cars	Av. No. Cars per Mo.	1st Mo.	2nd Mo.	3rd Mo.	4th Mo.	5th Mo.	6th Mo.	7th Mo.	8th Mo.	9th Mo.	10th Mo.	11th Mo.	12th Mo.	13th Mo.	14th Mo.	15th Mo.	16th Mo.	17th Mo.	18th Mo.
0	12	.67	1	1	0	1	1	0	1	1	0	1	1	0	1	1	0	1	1	0
1600	53	2.94	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3
100	37	2.06	3	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2
200	99	5.5	6	5	5	5	6	5	6	5	6	5	6	5	6	5	6	5	6	5
400	87	4.83	5	5	5	5	5	5	5	5	5	5	5	5	4	5	4	5	4	5
500	100	5.55	5	6	5	6	5	6	5	6	5	6	5	6	6	5	6	5	6	6
700	47	2.61	3	3	3	2	3	3	2	3	3	2	2	3	2	3	3	3	2	3
800	100	5.55	6	5	6	6	5	6	6	5	6	6	5	6	5	6	5	6	5	5
900	24	1.33	1	1	1	1	1	1	1	1	1	1	2	1	1	1	2	1	2	1
1300	19	1.06	2	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
1400	38	2.00	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2
1500	45	2.5	2	2	3	3	2	3	2	2	3	3	2	3	2	3	3	2	2	3
1600	1	.06	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0
Service Cars	11	.61	1	1	1	0	0	1	1	1	0	0	1	1	1	0	0	1	1	0
Total	671	37.27	36	37	36	37	37	36	37	37	37	37	37	38	37	37	37	36	37	37

Schedule for Overhauling Passenger and Freight Motive Equipment.

therefore, be comprehensive and well organized. All minor repairs, including the changing of wheels and armatures are made by the division foreman of the division on which the car is operated. For this rea-

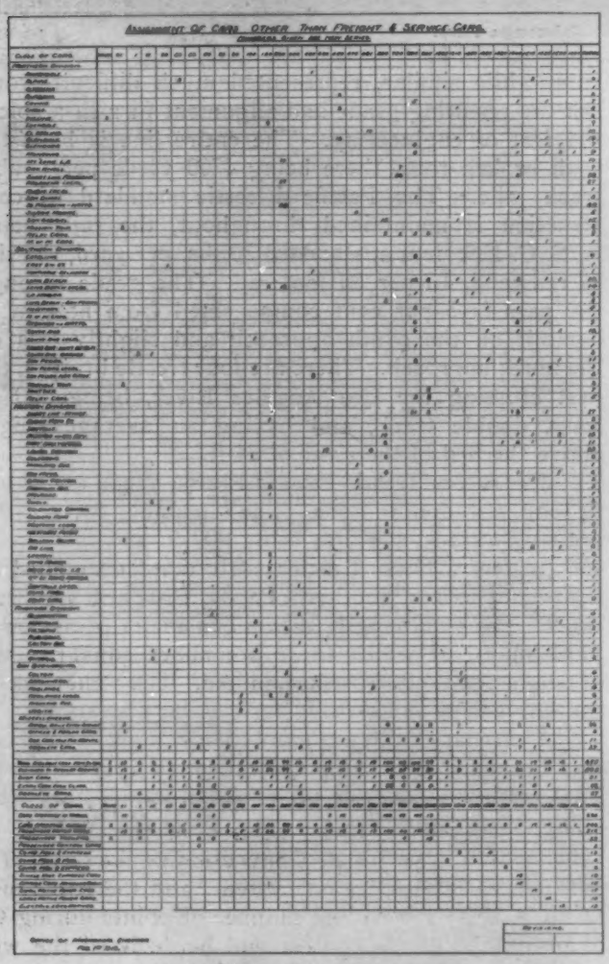


Chart Showing Car Assignment.

son he will not accept a car on his division until he is absolutely certain it is delivered to him from the shop, in perfect condition. As it is his duty to maintain the car in this condition he cannot return it for repairs until he has proof that the repair necessary is beyond the capabilities of the equipment with which he is provided. He, therefore, is held responsible for the condition of cars up to the point where the car actually needs to be returned to the shop. After a car has been in service, however, for a stated length of time it is returned to the shop for general overhauling.

A number of simple and effective office methods are used in connection with the mechanical engineering department. For instance, if there is a failure which requires the attention of the mechanical engineer, and in a system operated with the extreme high load factor of this system, such failure requires immediate attention; instead of following ordinary practice of issuing an order to a division foreman which he may not receive for several hours and which must be properly filed in the general company files, the notice of failure, immediately upon receipt is acted upon by the mechanical engineer. He telephones his order to the stenographer in the office of the foreman interested. The stenographer takes down the order, immediately handing one copy to the foreman, returning a copy to the mechanical engineer and sending a third copy for the general files. This accomplishes the desired purpose in the shortest limit of time without a long system of red tape, but at the same time keeping all records in perfect condition.

The average of failures for this system is one for each twenty-five to thirty thousand miles per car, or less than one per cent. A standard form showing in a vertical column the various routes and in the horizontal the various classes of cars used, enables each foreman to know the number and type of cars and the distribution over the system. Another simple form shows at a glance the time that every car has been in or out of the shop and gives both the master mechanic and the division foreman an instant knowledge of the probable condition of every car.

The total mileage of track operated in the three divisions approaches the one thousand mile mark and will soon pass this figure. This mileage is as follows:

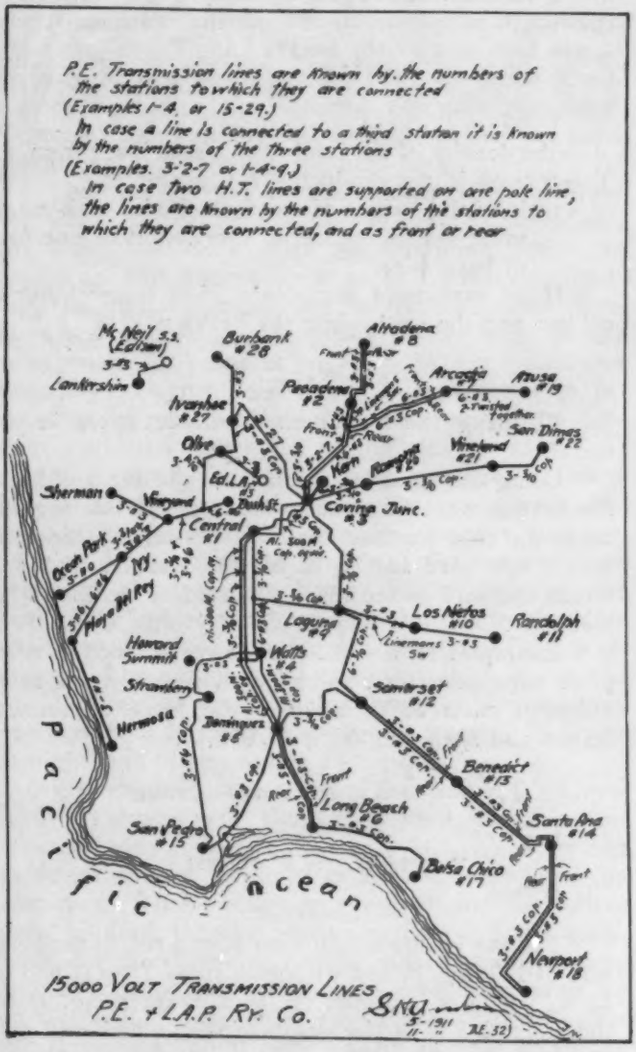
		Single Track Equivalent
Single track	219.88	219.88
Double track	253.61	507.22
Four-track	11.46	45.84
Joint track	5.37	10.74
Miscellaneous	99.96	99.96
S. P. Amoco-Santa Monica	7.8	15.6
		899.24

Added Equipment.

The recent consolidation has added a larger equipment which differs somewhat from former Pacific Electric standards. The newer cars of the Los Angeles Pacific Company are quite similar to those already in operation. A number of radical changes have been made with some of the older cars, in the lengthening by 8 ft. of the car body, and equipping with new trucks, General Electric motors and Type M multiple unit control. Fifty cars which originally were operated on the narrow gauge system were reconstructed by building new trucks for standard gauge, using the old motors and equipments.

Added Substations.

There are now 37 substations in active operation. Two portable substations which may be shunted, and placed in service at short notice at any point on the network where it may be necessary to centralize a large amount of power, and two central stations in operation in Los Angeles. The substations and electric operation are under the supervision of the electrical engineer, Mr. S. H. Anderson, one of the department heads, who has been with the system since its start.


P.E. Transmission lines are known by the numbers of the stations to which they are connected (Examples 1-4 or 15-29.)
In case a line is connected to a third station it is known by the numbers of the three stations (Examples. 3-2-7 or 1-4-9.)
In case two H.T. lines are supported on one pole line, the lines are known by the numbers of the stations to which they are connected, and as front or rear
Mt. Hoyl S.S. (Edison)
Burbank #26
Altadena #5
Lankirshim
Pasadena #2
Arcadia
Azusa #19
Ivanhoe #27
Olive
San Dimas #22
Vineland #21
Ed. L.A.P.
Sherman
Vineyard
Covina Junc. #3
Central #1
Ocean Park
Hoyo Bel Rey
Los Nietos #10
Randolph #11
Laguna #4
Howard Summit
Watts #8
Strawberry
Somerset #12
Hermosa
Domingues #6
Benedict #13
Long Beach #16
Santa Ana #14
San Pedro #15
Bolsa Chico #17
Newport #18
Pacific Ocean
15000 Volt Transmission Lines
P.E. + L.A.P. Ry. Co.

A late style of motor generator, of which there have been a number installed within the last year is of 1000 kilowatts capacity. The motor is of the synchronous type, but is provided with a squirrel-cage winding inserted in the pole faces, to allow starting as an induction motor. The generator is 6 pole with interpoles and is compounded to deliver the same voltage when at full load as at no load. The speed is 600 r.p.m. and there are but two bearings to the set. These sets were furnished by the General Electric Company.

A new substation approaching completion at Lankershim is quite similar to the Covina Junction station in its interior arrangements. It is, however, somewhat smaller than that station and will be provided with two 600 kilowatt General Electric motor-generator sets. This substation building is square, has six inch concrete walls and a concrete hip roof. While plain in appearance it is not unpleasing and is convenient and well designed.

Lankershim Substation.
Olive Substation.
Interior Olive Substation.

Power for the Western Division is supplied by the Los Angeles Edison Company to the various substations. The steam generating plant at Vineyard is operated as an auxiliary in a manner similar to the Los Angeles Central Station No. 1, by the Edison Company.

A "SEATTLE COMPETITION."

A spirited competition is on among the members of the Denver Company Section of the N. E. L. A., with a trip to the Seattle Convention as the goal. The plan embodies the "point system" and the two candidates gaining the largest number of points during the four months of the contest will be declared the winners and will have the trip to Seattle with expenses paid.

The sources through which credit may be gained include writing or discussing papers and questions at section meetings, gaining new members and regularity of attendance, as well as suggestions for the betterment of the section.

ECONOMIC CONDITIONS GOVERNING SPAN LENGTH.

BY R. S. BROWN.

The cost per mile of a transmission line, constructed over level country, is, for a given size of wire, determined by the number of poles or towers per mile. This would seem to indicate, as the criterion of cheapness, the use of long spans and few supports. Such construction, however, has the disadvantage that it requires supports of great height, since the sag for a given tension, is proportional to the square of the span length. The cost of a pole or tower capable of withstanding a given strain increases rapidly with the height due to the fact that the lateral dimensions must be increased along with the height. In the case of long poles the cost increases because of the scarcity of such timber.

If c be the cost in dollars of one complete structure, including insulators, transportation, erection, etc., and n the number of supports per mile, the total cost per mile will be, $D = cn$. If L be the length of span,

$$L = \frac{5280}{n}$$

and

$$D = 5280\,\frac{c}{L}$$

Let,

h = the height of support.
g = minimum allowable ground clearance.
s_o = maximum sag of conductor.
k = a constant.

Then,

$$s_o = kL^2$$
$$h = g + s_o$$
$$L = \frac{1}{\sqrt{k}}\sqrt{h-g}$$
$$D = 5280\sqrt{k}\,\frac{c}{\sqrt{h-g}}$$

For D to be a minimum,

$$\frac{dD}{dh} = 0,$$

hence,

$$\frac{dc}{dh}\sqrt{h-g} - \frac{c}{2\sqrt{h-g}} = 0.$$
$$h - g = \frac{c}{2}\,\frac{dh}{dc}$$
$$s_o = \frac{c}{2}\,\frac{dh}{dc}$$

That is, for a given size of conductor, the cost per mile of a transmission line will be a minimum when the maximum sag of the conductor is equal to one-half the cost of a support multiplied by the rate of change of height with cost.

This relation may be applied graphically by plotting the relation between c and h for supports of specified strength and from this curve plotting the function $g + \frac{c}{2}\,\frac{dh}{dc}$. The intersection of these two curves will give the proper value of h.

h may be found analytically as follows. Let c_1 and c_2 be the costs of two supports of heights h_1 and h_2 respectively. Assuming c to be the average of c_1 and c_2,

$$h = \frac{c_1 + c_2}{4}\,\frac{h_2 - h_1}{c_2 - c_1} + g$$

If the value of h as found from this equation falls between h_1 and h_2 it is the proper height of support, if it does not try new values of c_1, c_2, h_1, h_2, until it does, in which h_1 and h_2 should not differ by more than about five feet.

After the value of s_o is found by the above method the length of span is found from the relation,

$$L^2 = \frac{2Ts}{3rd}$$

Where,

d = the density of the conductor metal, lbs. per cu. in.
T = tension in the conductor, lbs. per sq. in.
r = ratio of the weight of one foot of wire with maximum loading of ice, to the weight of one foot of bare wire.

If the maximum sag occurs when the weather is coldest and the ice loading the heaviest,

$$L = \sqrt{\frac{2T_o s_o}{3rd}}$$

T_o being the maximum allowable stress in the metal.

Using this value of L, find what the sag will be in the hottest weather with no loading. If this sag exceeds the cold weather sag find by trial a value of L which will give sag s_o in hottest weather and will stress the wire to tension T_o in coldest weather with loading r.

Example: If a 40 ft. steel tower costs $350, complete with insulators, and a 45 ft. tower of the same strength costs $390, what is the most economical height and span length? g = 20 ft.

$$s_o = \frac{740}{4}\,\frac{5}{40} = 23 \text{ ft.} \quad h = 20 + 23 = 43 \text{ ft.}$$

Let

$$T_o = 30000 \quad r = 2 \quad d = .321$$

Hence,

$$L = 845 \text{ ft.}$$

The sag in this length span after a rise in temperature of 100 deg. F. and without loading (r = 1) will be 13 ft., which is less than the cold weather sag, 23 ft., therefore, 845 ft. is the length of span which will give the minimum cost of line.

POLE TREATING.

The San Joaquin Light & Power Company has found that untreated western yellow pine poles showed completely rotted stubs after 27 months' service on their line. Of those given a brush treatment with creosite 27 per cent showed signs of decay and of those brush treated with carbolinium 29 per cent showed signs of decay; of those treated with crude oil 45 per cent showed slight signs of decay. About 28 per cent of those treated with zinc chloride showed attack by decay. About 50 per cent of the entire number of poles tested were treated with creosote by the open tank method and these were found to be perfectly sound, showing no signs of decay whatever.

PRODUCING PROFITS—"VELVET."

BY ROSS B. MATEER, POWER EXPERT.

The installation of an elaborate sign, the contracting for tungsten street lighting, the outlining of a cornice, or an entire building, appeals more to the central station and its officers than a good day load. Go to many cities and the first outburst of enthusiasm over local conditions comes from the local officials when they mention lighting effects, signs, etc. Should you exhibit an interest in lighting conditions, you are requested to view the city by "artificial light." Your day is passed in viewing the offices and in conversation with the officials; the evening is spent in observing the "light." Some places you note are so lavishly lighted as to dazzle, yet near by is found a store or building almost dark. You pass from street to street, from building to building and find the same conditions, one dazzling, the next dark.

The next day you discuss revenue, then the gross and finally the net profits. When profit is mentioned, the analytical mind tries to determine what the profits are and whence derived. Is it the lavish lighting, the spectacular effects that are productive of an increased peak load that yields profit—large profit? A synonym for profit is "velvet." Where would one naturally look for the "velvet"? Surely not in increasing the peak business, but in increasing the daylight load—the power end of the plant.

No central station man who watches the earnings of his company can ignore the power end. He must admit to himself, though he does not acknowledge to others, that the profits of the company are produced not from the lavish display lighting, the beautifully lighted windows at night, but by the electric motor installed now for the operation of every industry. The motor, small or large, which drives the line shafting, or the individual motor-driven machine operated usually from seven in the morning until six at night, and often running 24 hours a day.

Why is the power revenue the "velvet?" A moment's thought will show that the central station must be ready to supply electricity 24 hours a day and sufficient current for light at the convenience of the customer. To be ready to supply light, the boilers must be fired, thereby consuming coal in large quantities, for the engine or turbine must be in operation, and in addition the switchboard attendants must be on duty. The expense is the same as when operating through a "night peak." The expense being the same, is it not evident that all the motor load secured that is in operation during the day, leads to an increase in the plant efficiency. Not only does this equal the expense of maintaining steam, but yields a handsome profit. Charge all the plant expenses to the lighting end and all the day power load is "rich velvet." Charge the daylight expenses of the plant to power and the incandescent expense is lightened. Upon the power business is placed much of the support of the incandescent and still the power business yields a good profit—"velvet."

"Velvet"—How Secured.

Central stations state they employ power salesmen, those who use the sharp pencil and the pad and can figure how much cheaper a customer can operate by the use of central station "juice." Power salesmen are good, but the central stations need more, they need power engineers. A power engineer should be competent to sell an electric appliance, a gas range, in fact, any commodity directly handled by his company. He should be a general man, conversant with all sides of the central station business, and his knowledge, together with a technical and practical training, results in power engineers—not power salesmen.

The power engineer is the general manager of the future. The banker, the accountant, the representatives of large interests, though head of the power companies now, will be replaced in the future by the power engineer, for he is the practical man, the worker, the one working directly for the stockholders' interest

Often it is not by pad and pencil and how much a power engineer can save a customer over present forms of power, but how a rearrangement of factory and its machinery, how the output may be increased by improved machinery and systems of operation; how much convenience in operation appeals to a prospective customer; and then how to secure the business without figuring dollars and cents.

The power engineer is a general man. He can figure on heat and its producing fuels; he has a good knowledge of effective, not wasteful illumination; sign and display lighting, effectively applied, is not new to him; the general saleswork of his company he has learned; a knowledge of accounts and how kept is his. This, with a technical training and practical experience, gives us today the man who produces the profit—the "velvet."

NAVY WIRELESS PLANS.

The U. S. Navy Department proposes to erect a high-powered wireless telegraph station on the California Coast for communication with similar stations on the Pacific, namely, one at North Head, opposite Astoria, one at Cordova, Alaska, and one at Unalga, near Unalaska. This California station is one of a chain across the Pacific Ocean, the others to be located at Pearl Harbor, Guam, Luzon, Tuituila and the Philippines, as well as one at the Panama Canal.

The location of the California station has not yet been determined and will depend upon the best facilities for wireless work offered by various localities. The Navy Department has been unable to buy land in the past as special authority is required from Congress.

It is being actively urged that this would make a desirable attraction for the Panama-Pacific Exposition if located at San Francisco, especially if operated in conjunction with the proposed Memorial Tower. The best site appears to be in Golden Gate Park near the ocean boulevard. If this land could be deeded to the Navy Department and if a 600 ft. tower could be erected by the exposition authorities or the marine and business interests the Navy would install the equipment.

POWER COMPUTATION OF ROTARY AIR COMPRESSORS.[1]

BY ROBERT SIBLEY.

The rapid rise of the steam turbine has led to much thought and study in application of the rotative idea to other reciprocating apparatus. The subject of centrifugal operation of pumps has received attention in a marked degree and has been developed to a high stage of efficiency. Since these pumps operate at high speeds they invariably occupy much less space and consequently have received great favor in recent installations.

The subject of air compression by means of centrifugal force has, within the last two or three years, received marked attention and the results produced have been most flattering to the inventors. In the March issue of the General Electric Review appears a paper by Dr. Louis C. Loewenstein on Centrifugal Compressors. The theory is there developed in a masterly manner but for the purpose of stepping this information still further down to the "primer" idea let us go into the elementary derivation of the equations of the centrifugal pump compressor.

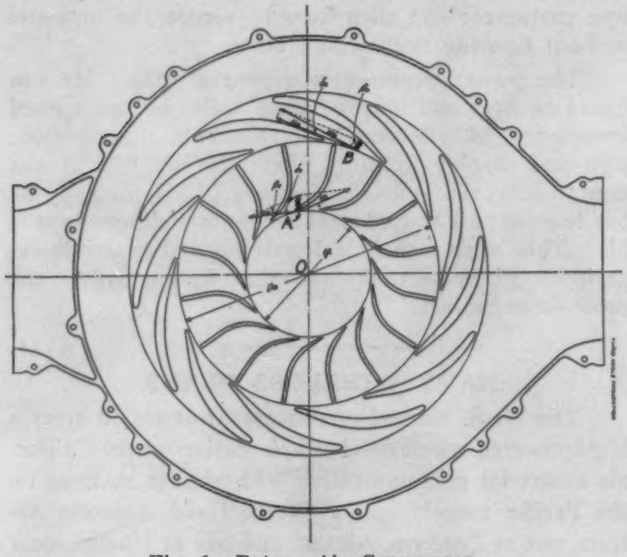


Fig. 1. Rotary Air Compressor.

In Fig. 1 is seen a diagramatic representation of the rotary compressor. The air enters from the center at the point A and is thrown outwardly at the point B due to centrifugal force. It is customary to allow this air to enter radially. The instant, however, the air reaches the rotating portions, this entering velocity w_e decomposes into two components, one component u_e traveling with the rotation of the wheel and the other component v_e along the rotating vane.

In elementary mechanics we learn that energy is never destroyed, consequently the energy of each pound of air at A must be equal to the energy of each pound of air at B, although the proportions of kinetic energy or energy of motion may be larger in one case than in the other. We shall expect then in considering the sum of the kinetic and potential energy that this sum shall be the same at either point, where allowance is made for added velocity energy at B due to the larger rotative value at B. We have previously learned in the study of thermodynamics that the product of pressure times the specific volume or pv represents the eternal energy of a gas under constant pressure, or in other words the energy necessary to force a given volume of air v into a reservoir under pressure of p lb. per sq. ft.

Let us suppose that the air is drawn in at a pressure and volume of p_1 and v_1 as graphically shown at A, in Fig. 2. After passing through the rotating vanes the air becomes compressed to a pressure and volume of p_2 v_2 shown at B. In the Twelfth Lecture of this series appearing in this Journal, November 25, 1911, we found that the work in ft. lb. necessary to compress a gas from A to B is equal to

$$W = \frac{R}{1-n}(T_1 - T_2) = \frac{p_2 v_2 - p_1 v_1}{n-1}$$

Now due to the air entering the rotating impeller under a pressure and volume of p_1 v_1, we really are aided in rotating the impeller by an amount of work equal to $p_1 v_1$ ft. lb. or the negative work required to force air against the entering pressure. On the other hand in order to deliver the compressed air into the reservoir which is at a pressure and volume of p_2 and v_2, a positive amount of energy $p_2 v_2$ ft. lb. is required. Hence the net work required to force each pound of air through the impeller and deliver it into the reservoir is

$$W = \frac{p_2 v_2 - p_1 v_1}{n-1} + p_2 v_2 - p_1 v_1$$

$$= \frac{n}{n-1}(p_2 v_2 - p_1 v_1)$$

$$= \frac{n p_1 v_1}{n-1}\left(\frac{p_2 v_2}{p_1 v_1} - 1\right)$$

and since we have previously found that a perfect gas obeys the law $p_1 v_1^n = p_2 v_2^n$, we have

$$\frac{v_2}{v_1} = \left(\frac{p_1}{p_2}\right)^{\frac{1}{n}} = \left(\frac{p_2}{p_1}\right)^{-\frac{1}{n}}$$

$$\text{or } W = \frac{p_1 v_1}{k}\left[\left(\frac{p_2}{p_1}\right)^k - 1\right]$$

$$\therefore \frac{p_2}{p_1} = \left(1 + k\frac{W}{p_1 v_1}\right)^k \quad \text{----------(1)}$$

in which k is equal to $\frac{n-1}{n}$.

Again it is often desired to obtain the average, or mean effective pressure of the air undergoing compression. The mean effective pressure is such a constant pressure as would be necessary to maintain throughout the compression assuming that the specific volume remained constant. Hence, if p is the mean effective pressure, we have at once

$$p v_1 = W$$

but from the value of W above deduced we, then, have

$$p v_1 = k\left[\left(\frac{p_2}{p_1}\right)^k - 1\right]$$

$$\therefore p = \frac{k}{v_1}\left[\left(\frac{p_2}{p_1}\right)^k - 1\right]$$

[1]This paper comprises the Twenty-fourth Lecture of a series appearing in these columns entitled Primer of Applied Thermodynamics.

It is often convenient to plot a curve from which values of p may be readily taken for varying values of p_a and vice versa. When this is once accomplished applications of equation (1) are materially simplified.

As air enters at A as shown in Fig. 3, it receives a total kinetic energy from the rotating impeller equal to $\frac{u_e^2}{2g}$ ft. lb. and when this pound of air arrives at B its total kinetic energy is evidently $\frac{u_a^2}{2g}$.

It seems that commercial designers prefer to have the air enter the impeller radially at A and leave with a relative velocity at B directed radially outward. Let us call b_e the angle between the entering relative velocity v_e and u_e, also call d_e the angle between the entering velocity w_e and the rotating velocity u_e. Let the subscripts a indicate at the point B similar angular and velocity relationships. Looking now at the point A, since the angle d_e is a right angle, we have at once

$$v_e^2 = u_e^2 + w_e^2$$

and again since at B the angle b_a is a right angle we have

$$w_a^2 = u_a^2 + v_a^2$$

If the outlet or inlet of this rotary compressor were closed for an instant, it is evident that, since there would be no movement of air, but simply a pressure at B in amount equal to the kinetic energy

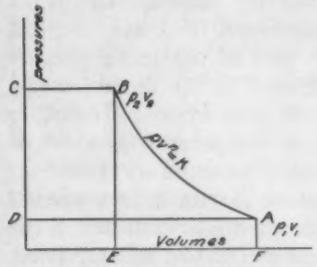


Fig. 2. Indicator Card for Rotary Air Compressor.

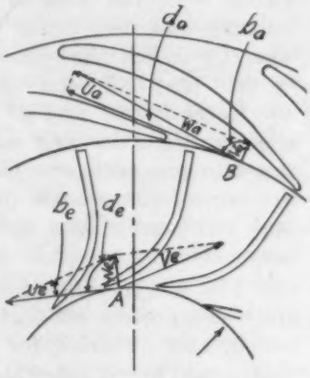


Fig. 3. Diagram of Velocities in Rotary Air Compressor.

of the air at that point, a pressure energy equal to $\frac{u_a^2}{2g}$ would be exerted. The instant, however, that the inlet is opened and a movement of air takes place, this pressure or potential energy would certainly be reduced by an amount equal to the kinetic energy of the air set in motion along the impeller blades, namely $\frac{v_a^2}{2g}$. Hence the potential energy of each pound of air delivered at point B is

$$\frac{u_a^2 - v_a^2}{2g}$$

Since, in addition to this potential energy, there is a movement of the air, evidently if we can convert eventually this additional kinetic energy into pressure or potential energy we can raise the pressure, or in other words, compress the air to even a much higher degree. This can be accomplished by properly guiding the air through stationary vanes after it has left the rotating impeller. By referring to the diagram it is seen that the absolute velocity of the air as it leaves the rotating impeller is w_a feet per second. Hence there is represented in each pound of air a kinetic energy equal to $\frac{w_a^2}{2g}$. If, then, we can recover this entire energy of motion and convert it into energy of pressure, we shall have a total pressure energy given to each pound of air, due to our rotary compressor, equal to

$$W = \frac{u_a^2 - v_a^2 + w_a^2}{2g} \qquad \text{.....(2)}$$

Substituting our value for w_a^2 which we have found to be equal to $u_a^2 - v_a^2$, we now have as the total energy possible to absorb into pressure or potential energy

$$W = \frac{u_a^2 - v_a^2}{2g} + \frac{u_a^2 + v_a^2}{2g} = \frac{u_a^2}{2g} \qquad \text{.....(3)}$$

Of course, it is impossible to recover this entire pressure energy. The ratio of the actual pressure energy obtained or in other words the ratio of the actual energy represented in the compressed air to that represented in our theoretic formula is called hydraulic efficiency, while the ratio of the actual energy represented in the compressed air to that required to be delivered at the shaft of the impeller in order to operate it is called the shaft efficiency.

In the multi-stage compressors, a series of these passages, one after the other, are passed through by the air, and, after passing through each series, the air is proportionally compressed to a high degree. If N represents the number of impellers or stages in series, the following energy should be absorbed by each pound of air from the rotating impeller.

$$W = e\,N = \frac{u_a^2}{g} \qquad \text{.....(4)}$$

Substituting the value of W in equation (1) we have

$$\frac{p_2}{p_1} = \left[1 + k\frac{e\,N\,u_a^2}{g\,p_1\,v_1}\right]^k \qquad \text{.....(5)}$$

This formula not only applies for air but also for carbon dioxide, nitrogen, hydrogen or any of the other so-called perfect gases.

Work is the product of force and distance through which the force acts. Let a be the net area in sq. ft. of the outlets of the impeller and v the velocity of the air in ft. per sec, leaving the impeller. Since p_a lb. represents the pressure over each sq. ft., the total pressure is $p_a a$ lb. This force acts through a distance of v ft. per second. Hence there are $p_a av$ ft. lb. of work being done every second. But (av) is the

quantity Q of air delivered each second, and, since 550 ft. lb. per second are equal to one horsepower, we have

$$H.P. = \frac{(p_2 - p_1)\,av}{550} = \frac{(p_2 - p_1)\,Q}{550} \quad \ldots\ldots\ldots\ldots\ldots\ldots (6)$$

By means of equations (5) and (6) we are thus enabled to determine at once the pressure of the compressed gas and the horsepower necessary to operate the impeller, be the gas air or any other of the perfect gases.

As an example let us compute the final pressure and horsepower necessary to operate a rotary air compressor which has 45 stages of compression, a shaft efficiency of 75 per cent, an outer peripheral speed of 400 ft. per sec., taking in air at 14.7 per sq. in., and delivering 1,000 cu. ft. per min.

We have previously found that for adiabatic compression of air, we have

$$n = \frac{c_p}{c_v} = \frac{.2375}{.1685} = 1.41,\ e = .75,\ p_1 = 14.7 \times 144,\ N = 45,$$

$$Q = \frac{10000}{60},\ g = 32.16,\ \text{and}\ v_1 = 13.1.$$

Hence substituting in equation (5), we have

$$p_2 = 14.7 \times 144 \left[1 + \frac{(1.41-1)}{1.41} \frac{.75 \times 45 \times 400^2}{32.16 \times 14.7 \times 144 \times 13.1} \right]^{3.44}$$

$$= 14.7 \times 144 \left[1 + 1.7605 \right]^{3.44}$$

$$= 14.7 \times 144 \times 32.9 = 69{,}650 \text{ lb. per sq. ft.}$$

or 484 lb. per sq. in.

Again we find the horsepower necessary by substituting in equation (6)

$$H\,P = \frac{(p_2 - p_1)\,Q}{550} = \frac{(69{,}650 - 14.7 \times 144)\,1000}{550 \times 60} = 205.8. \text{ Ans.}$$

Thermotwisters.

1. What would be the mean effective pressure of the air in the illustrative example in the above lecture?

2. A votary compressor operates with carbon dioxide under the same conditions given in the above example, what will be the final pressure and the horsepower required?

CONSERVATION AND USE OF NATURAL GAS.

The Bureau of Mines has just issued Technical Paper No. 10, Liquefied Products from Natural Gas; Their Properties and Uses, by Irving C. Allen and George A. Burrell, in an effort to show how natural gas, which is being allowed to escape almost without restraint in almost all of the petroleum fields of the country, may be conserved. The authors of the technical paper, in outlining their investigations, say:

By fractionating natural gas, either during or after liquefaction, four products can be commercially obtained. Roughly, these four products may be described as follows: (1) The gaseous product, the common natural gas of commerce; (2) the semi-liquid product, known as the new "wild" product, which should be used only as a liquefied gas and should be held in high-pressure steel containers only; (3) the light liquid product, or light gasoline used for blending with heavy naphthas; and (4) the heavy liquid product, or ordinary high-grade gasoline.

The possibility of handling the second product in the way that Pintsch and Blau gases are handled, enabling small towns, hotels and country estates to have the advantage of gas illumination, manifestly opens a new field of comparatively great importance in the natural gas industry and should add materially to the investments made in the so-called "natural gasoline" industry.

The liquefaction of gases by pressure is not a new industry, but only recently has its application to natural gas been recognized as practicable.

Up to the last two years the general practice in the manufacture of liquid natural gas was to make the product by compression of the gas in single-stage compressors operated at a pressure of 150 to 300 pounds per square inch. The one product obtained, so-called "natural gasoline"; was run into a tank and "weathered." The weathering consisted in allowing the lighter portions to volatilize spontaneously and escape into the open air until such time as the boiling away of the liquid had practically ceased. Thus the process involved a loss of 25 to 50 per cent, or even more. This loss was an absolute waste, not only of power and of cost of operating the engines and compressors but of the product itself.

The next step in the industry was to pass the waste gases (of which only the small quantity used for power had been utilized) from the single-stage compressor through a higher-stage compressor, thereby getting a second and more volatile product—a "wilder" liquid—which was run back into the first and mixed with the first or heavier condensate. This mixture was then again weathered to a safe degree, whereby it lost the greater part of the more volatile product that had been condensed in the second stage.

Recently the process had been improved another step, in that the first stage compressor product is run into one tank and handled as ordinary gasoline; the second compressor product is run into a second tank and handled as a lighter gasoline, with which the heavy refinery naphthas can be enriched or enlivened.

The last-mentioned method of using the second stage compressor product should receive wide recognition, and a market for the product should develop that would be no mean factor in the industry. Blending in the proportions of, say, 1 part of the product to 4 or 5 parts of the refinery naphthas makes these heavy naphthas more volatile and of greater value as fuel for automobiles; it also greatly increases their general usefulness. The proportions to be used in blending, however, must be determined more definitely by test.

The natural gas of this country frequently contains light products that do not condense in the second-stage compressor, and for which it is practicable and necessary to install three, four, and even higher stage compressors. These light products—true gases at ordinary temperatures and pressures—can be compressed and liquefied, but the liquid gases so obtained must be handled as gases and not as oils.

The mistake heretofore made in the "natural gas gasoline" industry, as some have recognized, has been the attempt to handle the light gaseous products as oils and not as gases.

PROPOSALS AFFECTING MEMBERSHIP IN THE A. I. E. E.

Realizing the immense importance of the present agitation among the members of the American Institute of Electrical Engineers to create an additional grade of membership, we have communicated direct with the secretary of the A. I. E. E., Mr. F. L. Hutchinson, and have received the following data relative to the transfer of members to the proposed grade of "fellow." Our own views may be found on the editorial page of this issue.

The matter of transfer of present Associates to the grade of Member, and present Members to the grade of Fellow, received long and careful consideration by the Additional Grade of Membership Committee and also by the Board of Directors of the Institute, as a result of which the plan provided in the proposed amendments was decided upon. Under this plan, a present Associate may be transferred to the grade of Member upon making application to the secretary prior to May 1, 1913, without the payment of a transfer fee, by referring to four Fellows or Members, who, upon inquiry, on a form which will be issued from the Secretary's office, shall certify that the applicant meets the requirements for the grade of Member as defined in the Constitution.

Similarly, a present Member may be transferred to the grade of Fellow by making application to the secretary prior to May 1, 1913, without the payment of a transfer fee, provided he refers to at least five Fellows or Members, who, upon inquiry, on a form which will be issued from the secretary's office, shall certify that the applicant meets the requirements for the grade of Fellow as defined in the Constitution. The requirements for the grades of Fellow and Member are given in full in the February proceedings.

At first, it was the intention of the committee to recommend that all present Members be automatically transferred to the grade of Fellow, but, inasmuch as the annual dues for Fellows under the proposed amendments will be $20, and the present dues of Members are $15, it was thought that it would not be just to automatically transfer Members without application, and therefore the provision was made that each Member should apply for transfer, but it should be understood that in making this application, it will not be necessary to submit a record of the applicant's training and experience, but merely to refer to at least five Fellows or Members. A simple form will be prepared which will be sent to the references. This form will contain the requirements as specified in the Constitution for the various grades of membership with a space in which the referee may state, whether, in his opinion, the applicant meets these requirements. Upon receipt of the required five favorable replies, the applicant will be transferred to the grade of Fellow. It is the expectation that there will be very few of the present Members who will not apply, consequently it is the belief of the committee and the board of directors, that practically all the present Members will become Fellows. Those, however, who do not desire to pay the additional five dollars annually for dues, or who, or any other reason wish to remain Members instead of becoming Fellows, may do so by simply refraining from making the required application.

There will, of course, be some of the present Members who will not be eligible for immediate transfer to the grade of Fellow, for the reason that one of the requirements for admission to that grade is that "he shall have been in the active practice of his profession for at least ten years," whereas, the corresponding requirement for admission to the grade of Member stipulates only five years of active practice. This increase in the number of years experience required, was carefully considered, and while it was recognized by the committee and by the board of directors that this would render ineligible for immediate transfer to the grade of Fellow a few of the younger Members, it was thought that this increase in the standard of the highest grade was desirable, and would work no great hardship upon the comparatively few Members who would be affected by it for the reason that it would simply require them to delay their transfer for one or two years.

The proposed amendments were recommended by the unanimous vote of the Additional Grade of Membership Committee and were approved by the unanimous vote of the Board of Directors.

A. I. E. E. CODE OF ETHICS.

The following code of principles of professional conduct of the American Institute of Electrical Engineers, was adopted by the Board of Directors, March 8, 1912. While the principles express, generally, the engineer's relations to client, employer, the public, and the engineering fraternity, it is not presumed that they define all of the engineer's duties and obligations.

A. General Principles.

1. In all of his relations the engineer should be guided by the highest principles of honor.

2. It is the duty of the engineer to satisfy himself to the best of his ability that the enterprises with which he becomes identified are of legitimate character. If after becoming associated with an enterprise he finds it to be of questionable character, he should sever his connection with it as soon as practicable.

B. The Engineer's Relations to Client or Employer.

3. The engineer should consider the protection of a client's or employer's interests his first professional obligation, and therefore should avoid every act contrary to this duty. If any other considerations, such as professional obligations or restrictions, interfere with his meeting the legitimate expectation of a client or employer, the engineer should inform him of the situation.

4. An engineer can not honorably accept compensation, financial or otherwise, from more than one interested party, without the consent of all parties. The engineer, whether consulting, designing installing or operating, must not accept commissions, directly or indirectly, from parties dealing with his client or employer.

5. An engineer called upon to decide on the use of inventions, apparatus, or anything in which he has a financial interest, should make his status in the matter clearly understood before engagement.

6. An engineer in independent practice may be employed by more than one party, when the interests of the several parties do not conflict; and it should be understood that he is not expected to devote his entire time to the work of one, but is free to carry out other engagements. A consulting engineer permanently retained by a party, should notify others of this affiliation before entering into relations with them, if, in his opinion, the interests might conflict.

7. An engineer should consider it his duty to make every effort to remedy dangerous defects in apparatus or structures or dangerous conditions of operation, and should bring these to the attention of his client or employer.

C. Ownership of Engineering Records and Data

8. It is desirable that an engineer undertaking for others work in connection with which he may make improvements, inventions, plans, designs, or other records, should enter into an agreement regarding their ownership.

9. If an engineer uses information which is not common knowledge or public property, but which he obtains from a client or employer; the results in the form of plans, designs, or other records, should not be regarded as his property, but the property of his client or employer.

10. If an engineer uses only his own knowledge, or information which by prior publication, or otherwise, is public property and obtains no engineering data from a client or employer, except performance specifications or routine information; then in the absence of an agreement to the contrary the results in the form of inventions, plans, designs, or other records, should be regarded as the property of the engineer, and the client or employer should be entitled to their use only in the case for which the engineer was retained.

11 All work and results accomplished by the engineer in the form of inventions, plans, designs, or other records, that are outside of the field of engineering for which a client or employer has retained him, should be regarded as the engineer's property unless there is an agreement to the contrary.

12. When an engineer or manufacturer builds apparatus from designs supplied to him by a customer, the designs remain the property of the customer and should not be duplicated by the engineer or manufacturer for others without express permission. When the engineer or manufacturer and a customer jointly work out designs and plans or develop inventions a clear understanding should be reached before the beginning of the work regarding the respective rights of ownership in any inventions, designs, or matters of similar character, that may result.

13. Any engineering data or information which an engineer obtains from his client or employer, or which he creates as a result of such information, must be considered confidential by the engineer; and while he is justified in using such data or information in his own practice as forming part of his professional experience, its publication without express permission is improper.

14. Designs, data, records and notes made by an employe and referring exclusively to his employer's work, should be regarded as his employer's property.

15. A customer, in buying apparatus, does not acquire any right in its design but only the use of the apparatus purchased. A client does not acquire any right to the plans made by a consulting engineer except for the specific case for which they were made.

D. The Engineer's Relations to the Public

16. The engineer should endeavor to assist the public to a fair and correct general understanding of engineering matters, to extend the general knowledge of engineering, and to discourage the appearance of untrue, unfair or exaggerated statements on engineering subjects in the press or elsewhere, especially if these statements may lead to, or are made for the purpose of, inducing the public to participate in unworthy enterprises.

17. Technical discussion and criticisms of engineering subjects should not be conducted in the public press, but before engineering societies, or in the technical press.

18. It is desirable that first publication concerning inventions or other engineering advances should not be made through the public press, but before engineering societies or through technical publications.

19. It is unprofessional to give an opinion on a subject without being fully informed as to all the facts relating thereto and as to the purposes for which the information is asked. The opinion should contain a full statement of the conditions under which it applies.

E. The Engineer's Relations to the Engineering Fraternity.

20. The engineer should take an interest in and assist his fellow engineers by exchange of general information and experience, by instruction and similar aid, through the engineering societies or by other means. He should endeavor to protect all reputable engineers from misrepresentation.

21. The engineer should take care that credit for engineering work is attributed to those who, so far as his knowledge of the matter goes, are the real authors of such work.

22. An engineer in responsible charge of work should not permit non-technical persons to overrule his engineering judgments on purely engineering grounds.

F. Amendments.

Additions to, or modifications in, this Code may be made by the board of directors under the procedure applying to a by-law.

CASH BOXES ELIMINATED.

Experiments in collecting fares from patrons of the "pay-as-you-enter" cars without the aid of the cash box have proven so successful that the Portland Railway, Light & Power Company has decided to remove the boxes from all the cars that have been so equipped. Hereafter passengers on the pre-payment cars will give their fares to the conductors direct. When it is necessary correct change will be given back and the passenger will pass into the car without stopping to drop a nickel into the box.

DATA ON HYDROELECTRIC DEVELOPMENT.

An interesting compilation of data on hydroelectric development in the United States has just been completed by Herbert Knox Smith, commissioner of corporations. This data has been presented to President Taft with recommendations. The increasing concentration or combination of hydroelectric enterprises has led Commissioner Smith to recommend that the government should preserve title to the remaining power sites and develop them to prevent a possible monopolization of public utility companies. Items from this report appear in the following lines.

The water power of the country, developed and practically capable of development at this time, probably does not exceed 25,000,000 horsepower. The total developed water power today is about 6,000,000 horsepower. The total stationary power used in the United States—steam, water and gas—is probably more than 30,000,000 horsepower.

The bureau of corporations, in its investigations, found concentration of water powers in three distinct phases. First, there is a centralization of control in each important locality; secondly, large interests influence a number of these local concerns, and finally there is found a growing relationship among the big interests.

In California six great power corporations, of which the most important is the Pacific Gas & Electric Company, with 118,343 horsepower, together control 375,000 horsepower, over 80 per cent of all the developed water power in the State.

In Washington two companies control 210,000 horsepower, or about 70 per cent of all developed water power.

In South Carolina, the Southern Power Company owns about 101,000 horsepower, or 75 per cent of the total commercially developed, with 73,000 horsepower undeveloped.

In the southern peninsula of Michigan the Commonwealth Power, Railway & Light Company controls 52,000 horsepower, or 73 per cent of the commercially developed, together with probably 71,000 horsepower more undeveloped.

Practically similar conditions exist in Montana, Colorado, Georgia and at Niagara Falls.

More important than this local centralization are the operations of ten large groups of interests which possess control or influence more than 1,821,000 developed horsepower, about 60 per cent of the commercial waterpower in the United States together with 1,449,000 horsepower undeveloped.

The General Electric interests control or influence 939,000 horsepower of developed water power in eighteen different States and 640,000 horsepower of undeveloped resources, a grand total of over a million and a half horsepower. Next are the Stone & Webster interests, which either own or strongly influence 278,000 horsepower, chiefly in connection with public service concerns. They exercise control, largely through management rather than ownership, over fifty-five or sixty companies. Eight have waterpower, the largest being the Mississippi River and Puget Sound region.

The other groups are the Hydraulic Power Company, of Niagara Falls, 144,000 horsepower; the Pacific Gas & Electric Company, with over 118,000 horsepower developed and the dominating factor in a large portion of California the group known as the Clark-Foote-Hodenpyl-Walbridge interests, 104,000 horsepower, largely dominating the water power situation in Michigan and also active in Maine and Oregon; the Southern Power Company, 101,000 horsepower, which owns the bulk of the commercially developed power in South Carolina; the S. Morgan Smith Interests, (Georgia) 76,000 horsepower; the Brady interests, (Tennessee) 70,000 horsepower; The United Missouri River Power Company, 65,000 horsepower, which with the Butte Electric Power Company (General Electric Group) practically dominates the power situation in Montana; and the Telluride Power Company (Colorado, Idaho and Utah) 65,000 horsepower. The last named nine interests also include under their influence 887,000 horsepower undeveloped.

Carrying the community of interests to a wider range, these groups show more or less relationship with each other. The two greatest, the General Electric and the Stone & Webster groups, have directors in a number of the same corporations, and the S. Morgan Smith, Westinghouse and Brady interests are similarly connected.

The companies in the General Electric group control street railways in sixteen towns, electric lighting plants in seventy-eight and gas plants in nineteen. Altogether, water power or allied companies own or control and operate street railways in 111 towns, electric lighting plants in 669 towns and gas plants in 113 towns.

The reasons for this are obvious. Control of the chief consumers of power both insures a market for power and excludes others. This connection between great power groups and the agencies that directly serve the public is of serious public significance.

A more general relationship of a sort not peculiar to water power, but nevertheless of broad public significance, is best illustrated in the General Electric Company. Men who are officers or directors in that company or of its three wholly controlled subsidiaries are also officers and directors in many other corporations. These other companies, with their subsidiaries, make a far-reaching group thus interconnected by active personal and financial relationship.

This one group of interrelationships controls or influences twenty-four corporations that operate hydroelectric plants; over fifty public service corporations, not counting as many minor subsidiaries; more than a dozen railroads; numerous industrial corporations; and, finally, over fifty banks and financial houses, many of them in the first rank of importance. About twenty General Electric men in all constitute most of this chain of connection, three of those being members of the firm of J. P. Morgan & Company, which is generally regarded as the dominant interest in the General Electric Company. These connections in no sense always mean control by the General Electric Company, or even identity of policy. They do, however, mean a striking degree of community interest.

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PACIFIC LUMBERMAN, CONTRACTOR AND ELECTRICIAN

CONTENTS

Pacific Electric Railway Consolidation 261
By Rudolph W. Van Norden.

Economic Conditions Governing Span Length 268
By R. S. Brown.

Pole Treating 268

Producing Profits—"Velvet" 269
By Ross B. Mateer.

Navy Wireless Plans 269

Power Computation of Rotary Air Compressors 270
By Robert Sibley.

Conservation and Use of Natural Gas 272

Proposals Affecting Membership in the A. I. E. E. 273

A. I. E. E. Code of Ethics 273

Cash Boxes Eliminated 274

Data on Hydroelectric Development 275

Editorial 276
The Telephone Combination.
The Corporation and the Commission.
Proposals Affecting A. I. E. E. Membership.

Personals 278

Trade Notes 278

Electrical Contractors' Notes 279

A. I. E. E. Meeting Notices 279

A. I. E. E. Committee on Organization of International Engineering Congress 279

Industrial 280
500,000 Volt Testing Transformers.
D. E. G. Electrolytic Generators.
New Catalogues.
A National Commercial Organization.

News Notes 281

A "Seattle Competition" 267

The Telephone Combination

That the Pacific Telephone & Telegraph Company should announce the absorption of the Home Telephone Company of San Francisco just one week before the California State Railroad Commission assumes its new duties of public service corporation regulation and control is apparently no mere coincidence but the result of the craftily calculated plans whereby the Bell company is now trying to stifle all competition on the Pacific Coast, irrespective of the desires of the people.

In the first days of electrical apprenticeship, the most lasting and impressive lesson taught is that of making a secure and efficient joint between two wires. The connecting ends should be prepared and carefully sand-papered in order that the binding material may perform its function with greater efficiency. Non-observance of instructions invariably resulted in a joint did not prove lasting but usually brought disaster and with it a considerable suffering in reputation.

The people of the great State of California gave vent to their will and feelings last fall—and justly too—in no uncertain manner in regard to regulation of public service corporations. Most of these corporations have not only signified their willingness to meet the people half way, but in many instances have won over the admiration and respect of the people by evidences of fair-mindedness. In fact the great body of conservative citizens of the State have largely changed their views and are loud in their praise of this attitude. The people are consequently coming into the belief that perhaps the heads of these corporations are at times like themselves almost human in their makeup.

The overt act of last Saturday on the part of the Pacific Telephone & Telegraph Company in boldly making a union without the expressed sentiment of the people when they knew that sentiment would be forcefully expressed in no uncertain terms one week later by a review of the State Railroad Commission not only discredits the telephone company but will have a tendency to put unfavorable and unjust criticism upon other corporations. How the rabid element in public service control will now gloat over the scalp of this combination if it can be legally secured. Those who are inclined to be fair-minded and conservative feel, too, that the act should be condemned. As in the improper forming of the soldered union without first preparing the joints for the binding material, we are taught to break the joint apart and do the work properly, so this combination should be disrupted, or at least thoroughly investigated and the will of the people in the way of reasonable control should be forcefully exerted.

Many who welcome the elimination of the duplicate telephone system, with its attendant inconvenience, find no fault with the consolidation, but only in the audacious manner of its accomplishment. But

that the ten million dollars, which is reported to have been paid for what will soon be little more than a pile of junk, should be included in the capital stock upon which they will be asked to pay dividends for all time to come is at once unjust and unreasonable.

The Corporation and the Commission

Individuals alone never succeed. Individuals are successful only as they make themselves so by helping the community. And so it will be in the life of the successful public service corporation of the immediate future. Corporations, like individuals, can only retain an education by giving it away to others, and the more people they give it to, the more education they will have left.

Candidness and open-minded fairness seem now to be characteristics of our western public service corporation regulation sentiment. Indeed, for getting at the true facts of costs and the fair fixing of rates, many of the western corporations are even going the commissioners one better in predetermining a just valuation—a valuation fixed upon such a firm and equitable foundation, no reasonable hearing will ever result in anything but affirmative approval.

The well-defined attitude of the largest hydroelectric enterprise on the coast—the Pacific Gas & Electric Company—may be cited as an instance of this newer and higher ethical development in corporation life. A corporation setting out with the avowed purpose of studying how to increase efficiency to the highest degree and how to fix scientifically just and absolute rates at all points of its great system, and, then, with this data in hand, as easily read as an open book, proposing to stand ready for any investigation, not only puts itself in the most favorable public light, but materially aids in increasing the efficiency of our nation. A careful compilation of cost data concerning hitherto unknown hydroelectric and steam generating deliveries means advanced methods and more efficient operation for human industries. Electrical energy possesses two unusual negative characteristics—it cannot be frozen and it can never be adulterated. The modern milkman, when delivering under a lax board of supervisors may continue to whiten up his liquid supply, and Mrs. Wiggs, when company arrives, may continue to add a little more water to the soup, but although the modern long distance transmission of electrical energy may resemble in one particular the proverbial lump of boarding-house butter, in which a little bit is said to go a long way, yet when electrical energy is applied this unadulterated gift of nature,—the captive power of the water fall—is delivered in its prestine purity.

When the wheels of industry are thus turning under the keen supervision of men versed in economic operation and in addition only a reasonable and fair return is asked for service delivery, our hydroelectric enterprises, now rapidly becoming the most substantial investments, may well feel secure for the future.

Proposals Affecting A.I.E.E. Membership

On January 1, 1912, the complete summary of membership in the American Institute of Electrical Engineers showed that there are at present 6 honorary members, 705 members and 6450 associate members, thus making a total of 7161.

A glance through the present large membership of the associate grade indicates that there is a great variation in engineering attainments. Here may be found chief engineers and designing engineers by the hundreds necessarily occupying the same status in the institute as the young engineer just out of college, embarking on an engineering career. This condition of affairs is a necessary adjunct to the present method of membership in the institute, for, since the reputation of an engineering society, is largely known from the composition of its highest grade, only those of preeminent attainments have been allowed to enter the present grade of member. This, then, accounts for the fact that at present the grade of membership constitutes only one-tenth of the institute enrollment.

The creation of the new grade of Fellow is, indeed, a happy thought. In recent years our profession has grown in importance and dignity. With this growth in dignity should come an advanced code of qualifications for highest attainments in our national body. At the same time the field of recognition for that great intermediate class should be widened, so that more of our deserving engineers can be recognized.

Any readjustment requires much agitation and often much injustice. The February proceedings of the institute give the details of the proposed change by which the present roll of members will pass into the grade of Fellow by certification of five members that the new constitutional provisions are met in the individual case under consideration. This certainly will accomplish the readjustment in as fair and equitable a manner as could be hoped for. For the good of the institute, it behooves all those having its welfare at heart to get active at once. To become effective, at least 30 per cent of the membership must vote upon the constitutional amendments, and 75 per cent of this vote must be affirmative. The coast members of the institute, ever yearning in synchronism with the highest ideals, ever ready to propose and support efficient means to accomplish these ideals, should perform their duty by favorable agitation and an early affirmative vote in behalf of the amendments.

Shades of old father Noah! Reports from Bagnio near Manila, P. I., show a recent precipitation of 3.60 inches of rain in one hour, 40 inches in 24 hours, and 80 inches in three days. Water must have fallen there as thick as shells on Dewey Day some years back. Anyhow there must certainly be available a few teaspoonfuls of storage water for the hydroelectric enterprises in the Philippines.

PERSONALS.

H. B. Squires of Otis & Squires is visiting Portland and Seattle.

Rudolph W. Van Norden, consulting engineer, is at Fresno.

Melville Dozier Jr., of Sacramento, was at San Francisco this week.

R. E. Starkweather, electrical engineer, is at Los Angeles on business.

L. R. Wiley, an engineer of Groveland, was a recent visitor at San Francisco.

H. C. Keyes, head of the Sacramento Gas Company, was a recent San Francisco visitor.

Nisbet Latta, vice-president and chief engineer of the Wisconsin Gas Engine Company, is at San Francisco.

J. B. Lukes, who represents the Stone & Webster interests, with headquarters at Reno, Nev., is at San Francisco.

C. O. Poole, of the firm of Manifold, Poole, consulting electrical engineers recently spent a few days at San Francisco.

Wynn Meredith, of the firm of Sanderson & Porter, has been at Los Angeles during the past week on important engineering business.

John S. Baker, district manager for the Crocker-Wheeler Company, has returned to his San Francisco office from a business trip through California.

John Coffee Hays, who manages the Mount Whitney Power Company and allied electrical interests, was at San Francisco from Visalia last week.

Bertram M. Downs, who recently resigned as vice-president and general manager of the Hemingray Glass Company, is making a tour of the Pacific Coast.

Thomas Mirk, of the firm of Hunt, Mirk & Co., has returned to San Francisco from San Diego, where one contract is nearly finished and another will soon be.

A. B. Cass, who is president of the Home Telephone Company of Los Angeles, and also manager of the Bay Cities Home Telephone Company, is at San Francisco.

A. M. Hunt, who recently returned to the United States after spending several months in touring Europe, is expected to arrive at San Francisco in about two weeks.

J. A. Clay, general manager of the San Juan Water & Power Company and the Triangle Gas & Electric Company of Durango, Colo., is a recent San Francisco visitor.

A. G. Wishon, general manager of the San Joaquin Light & Power Corporation, recently spent several days at San Francisco conferring with his consulting engineers.

Dr. Thomas Addison, Pacific Coast manager of the General Electric Company, is expected to reach San Francisco on his return trip from the Hawaiian Islands about March 26th.

O. W. Lillard, Pacific Coast manager for the Gould Storage Battery Company, with works at Depew, N. Y., has returned to his office at San Francisco after an extensive tour of the Pacific Northwest.

At a recent meeting of the Pacific Gas & Electric Company, J. H. Hunt, the purchasing agent, and Joseph C. Love, the assistant treasurer, were elected as directors in place of Louis Monteagle and J. S. Tobin, resigned.

G. I. Kinney, district manager of the Fort Wayne Electric Works at San Francisco, is making a trip throughout the eastern states in the course of which he will attend the annual convention of the Fort Wayne company at Fort Wayne, Indiana.

R. S. Buck, of the firm of Sanderson & Porter, left San Francisco recently for Salt Lake City, Utah, Boise and other Idaho cities, to investigate and report on the engineering features of certain irrigation projects.

W. A. Robb, local manager of the Western Union Telegraph Company at Portland, visited San Francisco during the past week as one of the large party who came by special train to select the site for the Oregon State building at the Panama-Pacific Exposition grounds.

J. T. Shaw, assistant division commercial engineer of the Pacific States Telephone & Telegraph Company at San Francisco, has resigned to accept a position with the California State Railroad Commission. Mr. Shaw's new duties will have particular reference to the telephone public utility companies.

C. H. Moore, district manager of the Pacific Telephone & Telegraph Company, with headquarters at Portland, was one of the 250 excursionists on the special train of twelve cars which recently arrived at San Francisco from Oregon. By the courtesy of his company a telephone switchboard was installed in the observation car and a station in each of the other cars. Connection with trunk lines was made from the train during the stops at the cities included in the itinerary. Among the other excursionists on the "Oregon First" train were R. J. Sheets of the Linkville Electric Company of Klamath Falls and George M. Hyland, president of the Mount Hood Railway & Development Company of Portland, and Mrs. Hyland.

TRADE NOTES.

An address illustrated with stereopticon views of Pittsburg and the Westinghouse shops was given at the last semi-monthly sales meeting of the Pacific Gas & Electric Company by Richard F. Behan, assistant to the district manager of the Westinghouse Electric & Manufacturing Company at San Francisco.

The Midway Gas Company has secured a franchise from the Kern County Supervisors for a 3-pipe line extending from the Midway oil fields to the Los Angeles County line. J. G. White & Co., the supervising engineers, have received notice of the shipment of a large quantity of the pipe through which natural gas is to be supplied for Los Angeles consumers.

The General Electric Company has sold a 15,000 kw. steam turbine and some large transformers to the Southern California Edison Company for installation at the Long Beach power plant near Ostend station. The apparatus is described as follows: One A. T. B. 8, 15,000 kw., maximum, (18750 k.v.a., at .8 power factor) 750 r.p.m., maximum rated vertical Curtis turbine generating set with condenser base. Also three F. O. 50 cycle, 6250 kw., 37600-65,000 Y., 11,000-v., forced oil type transformers.

A. I. E. E. COMMITTEE ON ORGANIZATION OF INTERNATIONAL ENGINEERING CONGRESS.

Gano Dunn, president of the American Institute of Electrical Engineers, has announced that the officers of the Committee on Organization of the International Electrical Congress of San Francisco 1915, will be: Dr. Charles P. Steinmetz, president; Dr. A. E. Kennelly, vice-president, in charge of program; C. O. Mailloux, vice-president, in charge of international relations; W. D. Weaver, vice-president, in charge of organization; Henry A. Lardner, vice-president, in charge of Pacific Coast relations; Dr. E. B. Rosa, of the United States Bureau of Standards, secretary; Preston S. Millar, of the Electrical Testing Laboratories, treasurer and business manager.

The body of the committee will be announced later, as will also be the advisory and honorary members, which are

to be chosen by the committee itself with the co-operation of the International Electrotechnical Commission and of the engineering, scientific and technical bodies of the United States, Canada and Mexico.

The memorial of the convention of delegates of American engineering societies held in San Francisco on January 15th to formulate plans for holding an International Engineering Congress at San Francisco, having been sent to all the members of the Board, which at its meeting in January voted to support such a general engineering congress, was referred to the Committee on International Electrical Congress for recommendations.

The directors' nominees for officers of the American Institute of Electrical Engineers for the ensuing year are as follows: For president, Mr. Ralph D. Mershon, of New York; for vice-presidents, Mr. William S. Murray, of New Haven, Mr. Arthur W. Berresford of Milwaukee, Mr. S. D. Sprong of Brooklyn; for managers, Prof. Comfort A. Adams of Cambridge, Mr. William B. Jackson of Chicago, Mr. J. Franklin Stevens of Philadelphia, Mr. William McClellan of Albany; for treasurer, Mr. George A. Hamilton of Elizabeth; for secretary, Mr. F. L. Hutchinson of New York.

A. I. E. E. MEETING NOTICES.

The Portland Section met in the Assembly Hall of the Electric Building at 8 p. m., Tuesday, March 19, 1912. E. D. Searing presented a paper, entitled, "The Steel Tower Transmission Line of the Portland Railway, Light & Power Company," giving some interesting details in regard to its design and construction.

The San Francisco Section of the American Institute of Electrical Engineers will meet at the Home Telephone Company's Building, 333 Grant avenue, at 8 p. m. A paper will be presented on the recent installation and performance of two large turbo-generators at Stations A and C of the Pacific Gas Gas & Electric Company, including the results of boiler tests at Station C by Frank H. Varney, Robert Sibley and R. F. Chevalier.

The March meeting of the Seattle Section, A. I. E. E. was held Saturday evening, March 16th, 1912, in the Assembly room, eight floor Central Building. Hydroelectric construction was the principal subject of this meeting. N. A. Carle of the Puget Sound Bridge & Dredging Company presented a paper on the Construction of Dams, taking up the failure of dams at Austin, Pa., and other places, and showing a design of dam which will prevent these failures. The paper was illustrated with a moving picture film and a number of slides. O. N. Wiswell, who has been in charge of the Snoqualmie Falls plant for eight years, presented a short paper on the Maintenance of Hydroelectric Plants, and an interesting discussion followed.

ELECTRICAL CONTRACTORS' NOTES.

F. Newberry, president of the Newberry-Benheim Electric Company, with offices in Chicago, New Orleans, Houston, Los Angeles and San Francisco, is spending a week in San Francisco looking after his local interests. On Wednesday, March 20th, Mr. Newberry met with the local contractors and gave them an interesting talk on the cost of running a contracting business.

The Turner Company has been awarded the wiring for a six-story Class C hotel, for Samuel Knight, on O'Farrell street, San Francisco.

The National Electric Company was awarded a $2000 job of wiring for A. H. Wilhelm at 323-325 Sutter street, San Francisco.

The following notes for contractors are from the pen of J. N. Pierce of Chicago, and well worth following:

1. Just keeping busy will not feed your families. There must be a profit in your work.
2. No man is a good enough guesser to keep his cost system by guess.
3. Exercise your philanthropy by contributing to the Associated Charities rather than furnishing work below cost.
4. Take care of the overhead charges or you will be underneath.
5. Taking jobs at exact cost is all right, providing the only thing a man needs is exercise.
6. If the overhead charges do not include your own salary, you must be working for the pure joy of labor.
7. Be sure you are right and then don't let the general contractor bluff you.

	First.
8. Cost of job	$5000
Overhead, 20 per cent	1000
	$6000
Profit, 10 per cent	$ 600
Your bid	$6600

	Second.
32 per cent of $5000	$1600
Cost of job	5000
Overhead and profit	1600
Your bid	$6600

Note.—See table for figuring net profits. Just a case of simple arithmetic.

9. Those who work for less than cost this year, will be working for something less next year.
10. The man without a cost system is trusting altogether too much to Providence.
11. If you don't know what your overhead is costing, hire a man who does know, to tell you.
12. It is by having a real rather than a paper profit on a job, that a contractor is able to make connections with money that will pass inspection at the bank.
13. Cut-throat competition is war, and war is hell.

Note.—Does this mean you?

The California State Electrical Contractors will meet in San Jose during the second week in August. We have the jobbers, manufacturers, Sons of Jove, Development League, and other electrical bodies. Why not turn the week at the Garden City into a big electrical get-together proposition. The contractors will show you a good time, as they have always done in the past. "How about that, Sandy?"

The Santa Barbara Grand Jury makes the following report.

"In the matter presented to our body by Mr. G. E. Potter, after examining Messrs. C. D. Kenyon, J. S. Reynolds, Claude Loveday, Fred Neilson and G. E. Potter, we find no grounds exist for indictment under the law against the Electrical Contractors' Association No. 7 of the California State Association of Electrical Contractors."

The following table is being distributed through California to all electrical contractors by the California State Association of Electrical Contractors:

TABLE FOR FIGURING NET PROFITS.

If your cost of doing business figured on gross sales is represented by one of these figures.

Your percentage of net profit is represented by the figure at the junction of the two columns.

EXPLANATION.—If your cost of doing business is 15% of your gross sales and you add 25% above cost of labor and materials your net profit is 5% on sales. If your cost of doing business is 18% and you add 60% above cost of labor and materials your net profit is 19⅛% on sales.

And you add to your cost of labor and materials one of these percentages.

	10%	11%	12%	13%	14%	15%	16%	17%	18%	19%	20%	21%	22%	23%	24%	25%
25%	10	9	8	7	6	5	4	3	2	1	00	1 Loss	2 Loss	3 Loss	4 Loss	5 Loss
33 1/3%	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	00
40%	18 3/5	17 3/5	16 3/5	15 3/5	14 3/5	13 3/5	12 3/5	11 3/5	10 3/5	9 3/5	8 3/5	7 3/5	6 3/5	5 3/5	4 3/5	3 3/5
50%	23 1/3	22 1/3	21 1/3	20 1/3	19 1/3	18 1/3	17 1/3	16 1/3	15 1/3	14 1/3	13 1/3	12 1/3	11 1/3	10 1/3	9 1/3	8 1/3
60%	27 1/2	26 1/2	25 1/2	24 1/2	23 1/2	22 1/2	21 1/2	20 1/2	19 1/2	18 1/2	17 1/2	16 1/2	15 1/2	14 1/2	13 1/2	12 1/2
75%	32 6/7	31 6/7	30 6/7	29 6/7	28 6/7	27 6/7	26 6/7	25 6/7	24 6/7	23 6/7	22 6/7	21 6/7	20 6/7	19 6/7	18 6/7	17 6/7
100%	40	39	38	37	36	35	34	33	32	31	30	29	28	27	26	25

INDUSTRIAL

500,000-VOLT TESTING TRANSFORMERS.

Notable among new equipments is a 500,000 volt testing transformer recently built by the Westinghouse Electric & Manufacturing Company, East Pittsburg, Pa., for insulation tests on high voltage power transformers and other high tension apparatus. Its design illustrates an ingenious handling of the problem of insulation, whereby this extremely high voltage is taken care of in a very satisfactory manner without increasing the amount of insulating material used, or the bulk of the apparatus, to an excessive degree.

It will be seen that the transformer has only one high tension terminal, the other end of the winding being grounded. As all insulation tests, almost without exception, can be made with one side grounded, this feature is not objectionable but on the contrary has many advantages.

It will be noted that, with one end of the high tension winding grounded, it is necessary to insulate the ungrounded end and also the high tension terminal for the full transformer voltage. On the other hand, if the middle point of the winding were grounded and both ends brought out through insulated terminals, it would be necessary to insulate the ends of the winding and the terminals for only one-half the transformer voltage; for example, if the voltage between terminals is 750,000, it would be necessary to insulate the winding and terminals to ground for only one-half this amount or 375,000 volts. From this it will be seen that the insulation problem for the given terminal voltage is a much more difficult one when one end of the winding is grounded than when the middle point is grounded. A considerable proportion of insulation tests made are from the windings of the apparatus under test to ground, and to make such tests with a transformer having the middle point grounded is most inconvenient because it necessitates the placing of the apparatus on a support insulated from ground for one-half the test voltage.

The problem of insulation is solved in an ingenious way. The insulation of the low-tension winding and between high-tension and low-tension, is a simple matter, accomplished by means of insulating cylinders. The high-tension winding is insulated from the core, not by interposing large masses of insulation, but by subdividing the high tension winding and so connecting the coils that the coil with maximum potential to ground is located at the greatest distance from the yoke. The ungrounded end of the winding is at the middle of the column of coils. The coils placed nearer to the yokes are nearer the grounded end of the winding and their potential to the grounded end of the winding and their potential to ground correspondingly less. The coils at the grounded end of the winding practically touch the yokes. The distance of the coil from the yoke increases with its voltage above ground, and the potential gradient from the ungrounded terminal is therefore fixed and uniform. The windings of this transformer have developed a voltage of 600,000 without any sign of distress.

The high-tension terminal is of the well-known condenser type, made of alternate layers of insulating material and tin foil so proportioned in length and thickness that the foil so proportioned in length and thickness that the potential gradient along the surface from line terminal to ground is approximately uniform. The large "hat" on top of the terminal is provided to prevent corona effect. The hat is made of wood, coated with tin foil. Its effect is to make the static field from line terminal to ground uniform, and to prevent concentration of static field. Without the hat, corona was present at about 350,000 volts. With the hat there is no corona up to 570,000 volts.

D. E. G. ELECTROLYTIC GENERATORS.

The standard type of generators for electrolytic work as offered by the General Electric Company, are 4-pole machines built in sizes 1.5 kw., 3 kw., 5 kw., 10 kw. and 15 kw. They run at the standard speed so that they may be direct driven by induction motors where alternating current of 60 cycles is available if so desired.

Thorough ventilation of the armature ensures cool running. Fan blades, fastened to the armature heads, in connection with air ducts, leading from the center of the core to the circumference, provide adequate ventilation of all parts. The bar windings which are insulated carefully, and connected at the end by copper ribbons, are inserted in insulated slots so that in case of accident to one or more bars, they can be easily removed without disturbing the remainder of the winding. All connections between the armature winding and the commutator are soldered to ensure that there will be no loose connections and consequent sparking at the brushes.

The field coils are wound on forms which permits their easy and quick removal from the poles in case of accident.

The D. E. G. 1 and 2 generators are arranged for one voltage only and consequently have but one commutator. They are self-excited generators and will give potentials of from 2 to 6 volts at 250 and 500 amperes, the voltage regulation being accomplished by varying the field.

The D. E. G. 3, 4 and 5 machines are of the double commutator design, the armature having two distinct windings, one being connected to each commutator. The terminals may be connected so that the two windings will be in series or in multiple, giving a potential equal to the sum of their voltages and the current equal to that generated by one, or a potential equal to that of one winding and a current equal to the sum of the currents from the two windings. The generator may also take the place of two generators, each winding serving as a separate machine.

NEW CATALOGUES.

The Westinghouse Electric & Manufacturing Company has issued folders 4100m and 4101 covering its 1912 line of fan motors. One of these folders is devoted to alternating current fans and the other to direct current fans. Attractive art covers add greatly to their appearance. The new line of steel frame fans is well illustrated and described therein.

The General Electric Company has just issued Bulletins 4926, 4927 and 4930. No. 4296 is devoted to The Application of Electricity to Marine Service, being printed in colors and describing the various pieces of apparatus and supplies manufactured by this company for marine use, and contains data of general interest to motor boat owners. No. 4927 describes the manufacture of Feeder Voltage Regulators. No. 4930 is devoted to the application of electric drive to ice and refrigerating plants, and illustrates the advantages offered by this method of drive as compared with steam power.

A NATIONAL COMMERCIAL ORGANIZATION.

In accordance with the terms of a statement from the President of the United States, the Secretary of Commerce and Labor has issued invitations to over one thousand of the leading commercial organizations of the country inviting them to send representatives to a general conference to be held at Washington, April 15. The idea is to establish a national organization broadly representative of the commercial interests of the whole country.

NEWS NOTES

INCORPORATIONS.

FRESNO, CAL.—Lewis Electric Company, $10,000, by H. W. and I. E. Lewis and S. E. Check.

MERCED, CAL.—Merquin Telephone & Electric Light Company, $25,000, shares $1 each, subscribed $10,150, by A. L. Bruce, David Larson, W. H. Joy, J. W. Bower et al.

SAN FRANCISCO, CAL.—Natomas Water Company, $5,000,000, shares $100 each, subscribed $500, by C. S. Goodrich, J. T. Piggott, G. O'Connor, R. K. Barrows and H. McCurdy.

LEWISTOWN, MONT.—The Lewistown Power Company has been incorporated here, capital $200,000. The company will erect a power plant on Spring creek and furnish the city and individuals light and power.

SAN BERNARDINO, CAL.—Articles of incorporation of the Interstate Telegraph Company, with principal place of business at Carson City, Nev., have been filed here. The company will complete telegraph lines in Nevada and California, and is capitalized at $100,000.

HOLTVILLE, CAL.—The Valley Telephone Company has been organized to take over the stock of the Eastern Telephone Company. A. E. Wright, P. C. Curtis and N. Shaw are directors. The capital stock is $25,000. A 150-mile line reaching to Calexico, Brawley, Imperial and El Centro will be constructed at once.

CANBY, ORE.—M. J. Lee, A. O. Echols and O. M. Lee have filed articles of incorporation, with capital of $100,000, under the name of Canby-Molalla Railroad Company. The company will build an electric line from here through the southeastern section of Clackamas county. It is understood eastern and Walla Walla capital are backing the enterprise.

SAN BERNARDINO, CAL.—Articles of incorporation of the Ontario & Upland Telephhone Company have been filed. The company intends to put in systems and connecting lines in Ontario, Upland and other cities in California. Capital stock $100,000, all of which has been subscribed. Directors, R. B. Campbell, W. A. Freemire, R. Grant White. Principal place of business, Ontario.

EL CAJON, CAL.—Articles of incorporation have been filed for the El Capitan Mutual Water Company, with a capital stock of $90,000. La Mesa is the place of business, with W. R. Andrews, T. J. Bryan, Lemon Grove, and C. H. Haven, Lakeview, as directors. The company will secure water from the water shed and bed of the San Diego River and distribute it to the users at cost.

RIVERSIDE, CAL.—Articles of incorporation have been filed of the Southern California Utilities Company which proposes to furnish power for San Diego, Riverside and Los Angeles Railway Company. Capital stock $10,000,000 with $50,000 subscribed. Riverside is the principal place of business. The incorporators are Charles E. Waite, M. M. Milloe and Lamont Simms of this city, E. Pelonbet of Los Angeles.

SAN DIEGO, CAL.—Articles of incorporation have been filed for the Union Water Company, with capital of $500,000. The company proposes to engage in business of boring artesian wells, and also proposes to build, construct, acquire, own, sell and convey, manage and operate reservoirs, dams, etc., for supplying consumers with water. The directors are Charles W. Taylor, Jerry Sullivan and O. Henry Cavage.

OAKLAND, CAL.—The Pacific Coast Carbon Company which proposes to manufacture all kinds of carbon products, such as are used in motors, dynamos, arc lights, batteries, etc., is to build a factory here. The company is composed of local capitalists, incorporated under the California laws in the amount of $300,000. R. C. Shaw is its president; A. G. Taft, vice-president; W. B. Straub and W. P. Swart, directors, and R. G. Erskine its secretary.

SAN FRANCISCO, CAL.—Articles of incorporation of the San Ramon Valley Railroad were filed with the county clerk recently. The road is to be seven miles long, and will connect Danville and Walnut Creek, in Contra Costa County. The principal place of business will be San Francisco. The capital stock is $250,000, divided into 2500 shares, of which $7400 has been subscribed. The five directors and their subscriptions are as follows: Jessie H. Steinhart, $7000; A. W. Jonas, $100; G. Miller, $100; S. S. Palmer, $100, and Geo. W. Merrill, $100.

SACRAMENTO, CAL.—Articles of incorporation have been filed by the Sacramento interurban railway, which proposes to construct an electric line connecting Sacramento, Fair Oaks, Orangeville and Roseville. The capital stock is $500,000, with $50,000 subscribed. D. W. Johnston of the North Sacramento company is the heaviest stock holder. Other directors are M. N. Williamson, Marshal Diggs, Ray C. Waring, A. D. Kildahl, Charles E. Hollister and James F. Elliott, all owners of North Sacramento lands. The proposed line will be 30 miles in length.

OAKLAND, CAL.—Articles of incorporation of the National Power Company, with a capitalization of $10,000,000, and in which a number of east bay city capitalists are interested, have been filed. The purpose for which the corporation is formed to deal in electric power and to acquire water rights for the generation of electricity. Oakland is named as the principal place of business, and the corporation is to exist for a term of fifty years. The stock is divided into 100,000 shares at a par value of $100 each. Twenty-five shares have already been sold and are held by the five members of the board of directors. These directors are Leon M. Gove, H. L. Breed, Charles Gross, J. E. Bowes and E. A. Herrman, all of Oakland.

SACRAMENTO, CAL.—The consolidation has been filed of the Tidewater & Southern Railroad Company and the Tidewater & Southern Railway Company into the Tidewater Southern Railway Company, with a capital of $5,000,000, of which $2,899,315 is paid up, to finance the construction of a system of electric lines through the San Joaquin Valley. The first named company was formed for the purpose of projecting a line from Stockton to Turlock via Modesto, a distance of 50 miles, and to build a branch line from Atlanta to Ripon, five miles. The last named corporation was organized to build from Turlock to Fresno, 97 miles, and to run branch lines to Los Banos via Newman, to Ceres, to Woods Colony, to Oakdale and to Manteca. The directors of the new company are: Karl C. Brueck, Byron A. Bearce, J. L. Craig, George Schuler, W. G. Wallace, T. J. Wisecarver and Frank A. West, of Stockton; J. A. Coley of Escalon; Ward B. Minturn, Frank Helm and W. M. Giffen of Fresno, M. D. Wood of Merced and Claus Johnson of Turlock.

ILLUMINATION.

FLORENCE, ORE.—G. G. Bushman has made application for an electric light and power franchise in this town.

INGLEWOOD, CAL.—The Inglewood Gas Company has been awarded a franchise to lay gas pipe lines in all public streets of Inglewood at $50,000.

TONOPAH, NEV.—Spontaneous combustion caused the destruction of the plant of the Nevada Gas Company by fire on March 8, the loss being $25,000.

OXNARD, CAL.—A special election is to be held April 5th to vote on question of issuing $30,000 bonds for a municipal lighting system. The bonds are to be of $500 each bearing 5 per cent interest, payable semi-annually on the first of June and the first of December. Two of said bonds shall be payable May 1, 1922, and two on the same date each year thereafter until all are paid.

GLENDALE, CAL.—Sealed proposals will be received for the purchase of electric light bonds in the amount of $30,000. Said bonds are twenty-year serials, 30 in number, each of the denomination of $1000, bearing 5 per cent interest, payable semi-annually on September 1st and March 1st, of each year. Two of said bonds are due on March 1st, 1915, and two on the same date of each year thereafter until all are paid.

FLORENCE, ORE.—At a special election here the vote was 48 to 8 in favor of granting to G. G. Bushman, of Sheridan, a franchise to maintain an electric lighting and power plant at this place. The franchise is for 25 years, and is not exclusive. Construction work will be begun soon and the plant will be read to furnish light by September. The plant will have a maximum lighting power of 100 kilowatt units. The town of Florence reserved a right to purchase the plant at any time after ten years from the date of the franchise.

KLAMATH FALLS, ORE.—The dispute between the city and the Klamath Falls Light & Water Company, as to the price of city lighting has been settled by the corporation getting the victory. Some weeks ago the council, on motion of Councilman G. W. Whit, chairman of the finance committee adopted a resolution to pay but 3½c instead of 5c per candle power. The bills of the company were rendered at 5c without regard to action of the council. There has been no contract between the city and the company and the latter was unwilling to make any concession in price unless there was a definite contract specifying a minimum candle power to be used by the city.

ANTIOCH, CAL.—Gas for light and fuel will be supplied to the cities of the north central section of the county by July of this year, according to the plans of Van E. Britton, promoter of the Contra Costa County Gas Company. Franchises for the laying of mains have already been secured from Antioch, Pittsburg and Martinez, and negotiations are in progress with Concord. The plans of the company include the construction of large trunk mains connecting the cities with the manufacturing plant which will be situated at Pittsburg. Construction work on the plant will begin about April with a large force of men. At the same time the laying of mains will be begun in Martinez and Antioch.

TRANSMISSION.

PRIEST RAPIDS, WASH.—The Pacific Power Company is contemplating the erection of a large dam here to generate electric power.

SEATTLE, WASH.—Bills have been presented to the City Council for the construction of a steam power plant on Lake Union for the city lighting department.

BELLINGHAM, WASH.—The Board of County Commissioners granted the Whatcom County Railway & Light Company a franchise to build a high power transmission line over the Guide Meridian road to the boundary, there to connect with the Western Canada Power Company.

JACKSON, CAL.—The General Electric Power Company has deeded to the Mokelumne River Power Company five locations covering 53,000 inches of water, three reservoir sites and one power house site. The deed follows a mix-up that occurred after the big power project had been launched by Promoter B. T. Bruce. Extensive litigation was promised.

WASHINGTON, D. C.—After charges had been made that a powerful lobby was at work to procure the adoption of the bill, the House has defeated, 98 to 27, a measure permitting the Hydroelectric Company, a water power corporation, to lay a pipe line across part of the Mono National forest reservation in California. Those opposed to the bill declared it affected the laws governing the National domain and would result in virtually nullifying them. The "water power" trust, it was charged, was behind the legislation.

PLACERVILLE, CAL.—Approximately $100,000 will be expended and 150 men will be employed by the Western States Gas & Electric Company on the work in this county that will take five months to complete. M. McCalman, engineer of construction for the county, is recruiting his force here. The company has a flume six feet wide which carries five feet of water. This flume is seven miles long and is eight years old. It will be practically rebuilt. This will require 1,000,000 feet of lumber. Considerable work will be done at the dam. The two miles of ditch will be dredged and new retaining walls put in.

BREMERTON, WASH.—Power for the navy yard will soon be supplied by the Olympic Power Company, now constructing a plant on the Elwha River near Port Angeles. In addition to its plans for the navy yard, the company is now negotiating with the Bremerton-Charleston Light & Power Company for furnishing electricity in Bremerton, Charleston and Manetto. The Elwha River plant will be in operation next month and the company promises its power lines will reach Bremerton in July. Final arrangements for furnishing power to the government here were completed recently at Washington by Thomas T. Aldwell for the company and the Secretary of the Navy.

CHICAGO, ILL.—Samuel Insull and H. M. Byllesby, heads of a local syndicate, have concluded details of the purchase of 40,000 shares or $4,000,000 of the common stock of the Pacific Gas & Electric Company of San Francisco. The price paid is understood to have been around 62½. The outlay involved is about $2,500,000. The stock was sold by the estate of N. W. Halsey. It appears that Insull and his asociates have been buying up the common stock of the Pacific Gas & Electric Company over a considerable period, with a view of gaining a substantial foothold in the gas, electric and power companies of the Pacific Coast. The plans are rather ambitious and the purchase of these shares is merely a start.

SAN JOSE, CAL.—The borrowing of $100,000 is contemplated in the action taken recently by the San Jose Terminal Railway Company for the completion of the electric line between San Jose and Port Alviso and for the steamer line between Alviso and San Francisco. A certificate of the creation of a bonded indebtedness was filed this morning in the office of the county clerk by the company, which was recently organized in this city. The corporation will issue 5 per cent 20 year bonds for $1,000,000 of a denomination of $1000, secured by the capital and holdings. The firm was incorporated for $2,500,000, and $1,512,525 has been subscribed. The directors are Hugh Center, H. J. Gardner, John A. Mehling, J. J. Mahoney and H. H. McCloskey.

TRANSPORTATION.

SALEM, ORE.—Contracts for building a depot for the Oregon Electric Railway will be let in a few days, and work will begin soon as awarded.

PORTLAND, ORE.—The Southern Pacific has authorized an expenditure of $500,000 within the next three months in the work of electrification of its west side lines and work on its new east side freight facilities.